ABSTRACT

Through this paper, the authors propose a new approach to get fault tolerant multi-agent systems using learning agents. Generally, the exceptions in the multi-agent system are divided into two main groups: private exceptions that are treated directly by the agents and global exceptions that combine all unexpected exceptions that need handlers to be solved. The proposed approach solves the problem of these global exceptions using learning agents. This work uses a formal model called hierarchical plans to model the activities of the system’s agents in order to facilitate the exception detection and to model the communication with the learning agent. This latter uses a modified version of the Q Learning Algorithm in order to choose which handler can be used to solve an exceptions. The paper tries to give a new direction in the field of fault tolerance in multi-agent systems by using learning agents, the proposed solution makes it possible to adapt the handler used in case of failure within the context changes and treat repeated exceptions using learning agent experiences.

Keywords: Exception Handling, Fault Tolerance, Global Exception, Hierarchical Plans, Learning Agents, Private Exception, Q Learning Algorithm

1. INTRODUCTION

Fault tolerance means to avoid service failures in case of fault, for this reason, adding fault tolerance to multi-agent system is the main goal of researchers in this field. This propriety improves the functionality of the system and increases the applications dependability. There are many solutions proposed to get fault tolerant multi-agent systems. Some solutions are based on the replication as best solution for agent failures. (Almeida et al, 2006, Guessoum et al, 2010) propose that each agent must have copies that can replace the agent in case of failure. This solution is very costly in term of management since each agent of the system will have a number of copies that must be updated each time. Exception handling or adding handlers to solve failures that may occur
within the multi agent system is also a way to get fault tolerant multi agent systems. The two approaches proposed in (Haegg, 1997, Bouzahzah & Maamri, 2012) use additional agents to handle exceptions. The approaches in (Dellarocas et al, 2000, Souchon et al, 2004) use frameworks to identify the exception and prescribe the solution, these approaches are effective in some cases, but, they do not deal within the case when the exception depends of the context changes. These solutions, also, do not recognize if an exception is treated before or not, they treat each detected exception as new ones, even, if it is repeated this feature causes a great waste of time.

To get a multi agent system that can solve agent exceptions, choose the best solution in case where there is more than one handler and, in case of repeated exceptions, the solution is chosen directly, this work proposes a new approach for exception handling in multi agent systems using learning agents. This approach uses the hierarchical plans to model the activities of the system’s agents to facilitate the exception detection. Then, it proposes a communication protocol that allows the communication between the system’s agents and the learning agent. This learning agent uses a modified algorithm inspired from the Qlearning Algorithm to join the exception detected within the handler that assures the best reward. This approach, also, uses a memory inspired from the one proposed in (McCallum, 1996) to deal within repeated exceptions. It proposes the idea of learning from other learning agents in case of an exception that cannot be solved by the existing handlers and it may cause the system failure.

The rest of this paper is organized as follows: the coming section surveys different approaches of fault tolerance using exception handling and discusses their limitations. The third section gives the general architecture of our system and shows its main parts. The forth section describes the proposed approach and explains how the learning agent is used to add fault tolerance to the multi agent system. The learning agent treats the exceptions using modified version of the Qlearning Algorithm if the detected exception is a new one, and uses its experiences if it is a repeated exception. Section five, shows the experimental results of our work, discusses how these results support the proposed approach and compares them with the ones described by other approaches. Finally, the last section concludes our paper and gives an insight concerning our further works.

2. RELATED WORK

The multi agent system is defined as system composed of agents situated in some environment and interacted according to certain relations. Multi agent systems are used largely when dealing within applications that need decentralization and cooperation. Unfortunately, these systems are prone to failures of different sources. Researchers in field of fault tolerance propose many solutions to get robust multi agent systems. Exception handling represents one of the solutions used to assure fault tolerance, it solves exceptions that occur during the system execution. This technique is proposed, in reality for distributed and concurrent systems but it is, later, used for multi agent systems.

Several works have been proposed to ensure fault tolerance in multi agent systems using the technique of exception handling, some of them use special agents that monitor the system’s agents and handle exceptions such as the approach proposed in (Haegg, 1997) it uses a sentinel system to monitor each agent of the system. A sentinel is a special agent who plays the role of a gatekeeper which controls the incoming and outgoing messages of the agent to detect the undesirable situations. The problem with this approach is that the sentinel must have details of the work to ensure agent’s control. The approach proposed through this paper solves this problem by using the learning agent that does not necessarily has the details of the work to solve the exceptions, since the system’s agents have the ability to control and
Intelligent Reasoning Approach for Active Queue Management in Wireless Ad Hoc Networks
www.igi-global.com/chapter/intelligent-reasoning-approach-active-queue/24331?camid=4v1a

A Novel Wireless Mobility Monitoring and Tracking System: Applications for Smart Traffic
www.igi-global.com/article/a-novel-wireless-mobility-monitoring-and-tracking-system/176587?camid=4v1a